

Methods of measurement for radio transmitters —

Part 1: General characteristics for broadcast transmitters

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Summary of pages

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Methods of measurement for radio transmitters
Part 1: General characteristics for broadcast transmitters
(IEC 60244-1:1999)

Méthodes de mesure applicables
aux émetteurs radioélectriques
Partie 1: Caractéristiques générales
des émetteurs de radiodiffusion
(CEI 60244-1:1999)

Meßverfahren für Funksender
Teil 1: Allgemeine Kenndaten für
Rundfunksender
(IEC 60244-1:1999)

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of document 103/14/FDIS, future edition 2 of IEC 60244-1, prepared by IEC TC 103, Transmitting equipment for radiocommunication, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60244-1 on 2000-01-01.

This European Standard supersedes HD 236.1 S1:1977.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2000-10-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2003-01-01

This standard is intended to be used in conjunction with the various parts of EN 60244.

Annexes designated "normative" are part of the body of the standard.

Annexes designated "informative" are given for information only.

In this standard, annexes C, D and ZA are normative and annexes A, B and E are informative.
Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60244-1:1999 was approved by CENELEC as a European Standard without any modification.

In the official version, for annex E, Bibliography, the following notes have to be added for the standards indicated:

- | | |
|--------------|--|
| IEC 60060-1 | NOTE: Harmonized, together with its corrigendum March 1990 as HD 588.1 S1:1991 (not modified). |
| IEC 60060-2 | NOTE: Harmonized as EN 60060-2:1994 (not modified). |
| IEC 60099-1 | NOTE: Harmonized as EN 60099-1:1994 (not modified). |
| IEC 60244-9 | NOTE: Harmonized as EN 60244-9:1994 (not modified). |
| IEC 60244-11 | NOTE: Harmonized as EN 60244-11:1993 (not modified). |
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METHODS OF MEASUREMENT FOR RADIO TRANSMITTERS –

Part 1: General characteristics for broadcast transmitters

1 Scope

This part of IEC 60244 defines the general characteristics of broadcast transmitters and standardizes the conditions and methods of measurement to be used to ascertain the performance of a broadcast transmitter and to make possible the comparison of the results of measurements made by different observers.

The methods of measurement detailed in this standard are intended for type tests and may also be used for acceptance tests and factory tests (see clause 3).

This part of IEC 60244 does not specify limiting values of the various quantities for acceptable performance, as these should be given in the relevant equipment specification, preferably in the form laid down in an appropriate IEC recommendation.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 60244. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on part of IEC 60244 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60244-5:1992, *Methods of measurement for radio transmitters – Part 5: Performance characteristics of television transmitters*

IEC 60244-13:1991, *Methods of measurement for radio transmitters – Part 13: Performance characteristics for FM sound broadcasting transmitters*

IEC 60244-15:—, *Methods of measurement for radio transmitters – Part 15: Amplitude-modulated transmitters for sound broadcasting¹⁾*

IEC 600651:1979, *Sound level meters*

ISO 3744:1994, *Acoustics – Determination of sound power levels of noise sources using sound pressure – Engineering method in an essentially free field over a reflecting plane*

ISO 3745:1977, *Acoustics – Determination of sound power levels of noise sources using sound pressure – Precision methods for anechoic and semi-anechoic rooms*

¹⁾ To be published.

ITU-R Recommendation 328-7 – *Bandwidth*

ITU-R Recommendation 559 – *Standard coloured noise signal*

ITU-R Report 275 – *Bandwidth*

ITU-R Report 324 – *Bandwidth*

Radio Regulations and appendices: Geneva, 1990

3 Definitions

For the purposes of this part of IEC 60244, the following definitions apply.

3.1

broadcast transmitter

equipment producing radiofrequency energy for the purpose of terrestrial broadcasting

NOTE For the purpose of this standard, such auxiliary equipment as is necessary to maintain the transmitter in normal operation, together with any device to match the impedance of the antenna (or the antenna transmission line) to the transmitter, including harmonic or other filters, are to be considered as part of the transmitter.

3.2

broadcast transmitting system

equipment comprising a broadcast transmitter connected to its antenna or antennas, or several transmitters connected to a common antenna

NOTE Unless specifically indicated, this standard refers only to single broadcast transmitters.

3.3

type tests

series of tests including a design evaluation carried out on a representative sample of the transmitting equipment, with the object of determining that a particular manufacturer can be considered capable of producing products meeting the specification

3.4

factory tests

tests carried out by the manufacturer to verify that his products meet the specification

3.5

acceptance tests

tests to determine the acceptability of a consignment of transmitting equipment, carried out in the factory, or on site after commissioning the equipment, on the basis of an agreement between customer and manufacturer

The agreement shall cover

- a) the sample size;
- b) the selection of the tests;
- c) the extent to which the results of the selected tests should conform to the specification.

NOTE In the event of divergent test results, IEC standard test methods should be employed.

4 General conditions of measurement and operation

The operating conditions given in column a) shall apply during the measurements to confirm that the equipment meets the performance specification.

Outside the operating conditions in column a) but within the extended limits of column b), the performance specification limits may be relaxed, subject to acceptable transmission performance and conformity with the requirements of the Radio Regulations. It is desirable that the limits for such relaxed performance should be given in the specification.

	a)	b)
4.1 Temperature in the operating room	5 °C to 35 °C	1 °C to 45 °C
4.2 Relative humidity in the operating room	up to 75 %	up to 90 % (maximum temperature 26 °C)
4.3 Cooling air temperature*		
– entering the cooling system	–20 °C to +35 °C	–25 °C to +40 °C
– entering the transmitter	15 °C to 35 °C	–20 °C to +45 °C
4.4 Relative humidity of the cooling air entering the cooling system up to 25 °C	up to 95 %	up to 95 %
4.5 Air pressure	720 hPa to 1 060 hPa	720 hPa to 1 060 hPa
4.6 Immunity against mechanical vibrations airborne or air pressure related to 2×10^{-5} Pa	up to 80 dB	up to 100 dB
4.7 Immunity against RF fields within the broadcasting bands		
– electric field strength, minimum	up to 10 V/m	up to 10 V/m
– for special requirements	up to 100 V/m	up to 100 V/m
4.8 Immunity against magnetic fields	up to 4 A/m	up to 4 A/m
4.9 Mains voltage**	+6 % to –10 %	sudden change of ± 10 % of nominal value
4.10 Mains frequency	± 2 %	± 5 %

NOTE For transmitters of power above 100 kW, where compliance with these conditions is problematical, the manufacturer should stipulate the alternative limits he finds acceptable.

5 General performance characteristics

5.1 Transmission systems (article 4.2 of the Radio Regulations)

The Radio Regulations designate emissions by a combination of numerals and letters according to their necessary bandwidth and classification. The designation for the necessary bandwidth always precedes the designation for the class of emission.

5.1.1 Designation of necessary bandwidth (article 4.2 of the Radio Regulations)

The necessary bandwidth, rounded to three significant figures, is expressed by three numerals with a letter in the position of the decimal point to represent the unit of bandwidth. H, K, M or G, respectively, are used for Hz, kHz, MHz and GHz.

* For liquid cooled transmitters, special agreements are to be applied.

** The output power of transmitters may vary dependent on the variation of the mains voltage.

5.1.2 Designation of class of emission (article 4.2 of the Radio Regulations)

First symbol – Type of modulation of the main carrier	Symbol
Emission of an unmodulated carrier	N
Double sideband	A
Single sideband, full carrier	H
Single sideband, reduced or variable level carrier	R
Single sideband, suppressed carrier	J
Independent sidebands	B
Vestigial sideband	C
Frequency modulation	F
Phase modulation	G
Second symbol – Nature of signal(s) modulating the main carrier	
No modulation signal	0
A single channel containing quantized or digital information without the use of a modulating subcarrier	1
A single channel containing quantized or digital information with the use of a modulating subcarrier	2
A single channel containing analogue information	3
Two or more channels containing quantized or digital information	7
Two or more channels containing analogue information	8
Composite system with one or more channels containing quantized or digital information, together with one or more channels containing analogue information	9
Third symbol – Type of information to be transmitted	
No information transmitted	N
Telegraphy for aural reception	A
Telegraphy for automatic reception	B
Data transmission, telemetry, telecommand	D
Telephony (including sound broadcasting)	E
Television (video)	F
Combination of above	W
Additional characteristics (appendix 6 of the Radio Regulations)	
Fourth symbol – Details of signal(s)	
Two-condition mode	A
Sound of broadcasting quality (monophonic)	G
Sound of broadcasting quality (stereophonic)	H
Monochrome	M
Combination of above	W
Colour	N
Fifth symbol – Nature of multiplexing	
None	N
Frequency-division multiplex	F
Time-division multiplex	T

5.1.3 Examples

Example 1: 6M 25 C3FNF is the designation for a vestigial sideband, single-channel analogue television (video) emission in colour without any multiplexing. The necessary bandwidth is 6,25 MHz.

Example 2: 750 K F8EHN is the designation for an FM two-channel television sound broadcasting emission in stereo, without any multiplexing. The necessary bandwidth is 750 kHz.

5.2 Frequency (range, stability, etc.)

5.2.1 General

In order to achieve effective use of the radiofrequency spectrum and limit mutual interference caused by radio services occupying adjacent channels, any departure from the frequency assigned to a transmitter shall be kept within strictly observed limits. These are defined by the International Telecommunications Union and are laid down in the Radio Regulations (see annex C).

5.2.2 Characteristic frequency

A frequency which can easily be identified and measured in the occupied band of an emission.

The term "characteristic frequency" is used in this standard to denote the actual frequency of that component of the emission, the nominal value of which is the assigned frequency.

5.2.3 Frequency tolerance

The frequency tolerance is the maximum permissible departure of the characteristic frequency of an emission from the assigned frequency. The frequency tolerance is expressed in parts per 10^6 or in hertz.

5.2.4 Frequency stability

The frequency stability is the extent to which an emission maintains its assigned frequency within frequency tolerances.

A random departure from the assigned frequency is expressed as frequency error.

5.2.5 Frequency error

The frequency error is the difference between the assigned frequency and the characteristic frequency, and shall not exceed the specified frequency tolerance.

The maximum frequency error is expressed in hertz and shall be compared with the frequency tolerance in the Radio Regulations or with the relevant statement in the equipment specification.

5.2.6 Frequency drift

The frequency drift of an emission is the uncontrolled continuous and irreversible variation of frequency against a predetermined timescale.

The latter should be chosen to identify either short-term or long-term frequency variations, expressed in hertz against a defined timescale (see figure 1).

The frequency drift can also be expressed in $10^6 (\Delta f/f_0)$.

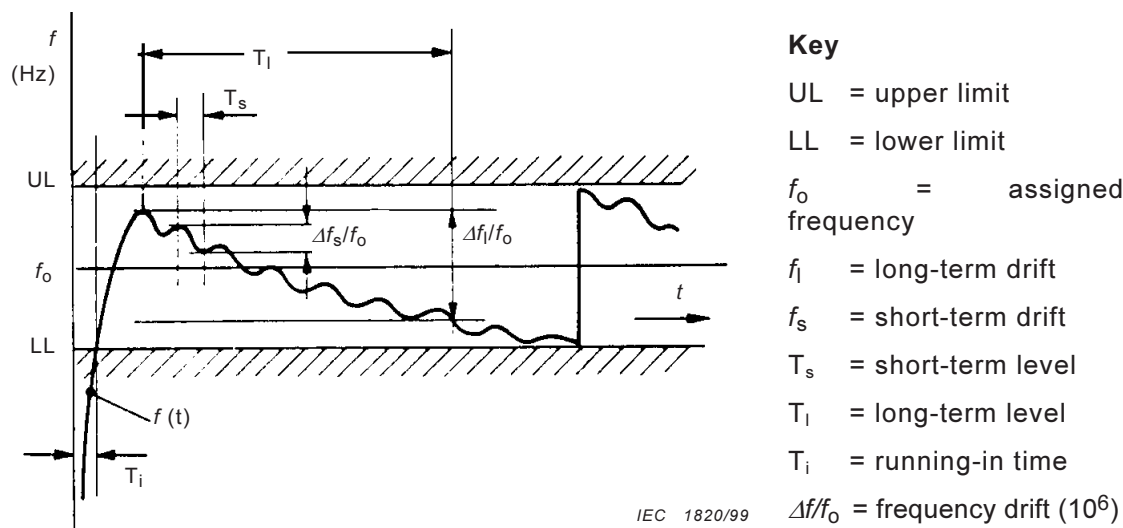


Figure 1 – Example of frequency drift as a function of time $f(t)$

5.2.7 Frequency setting error

When a transmitter is set to a particular frequency, the characteristic frequency obtained will generally differ from the assigned frequency. This is the frequency setting error.

5.2.8 Conditions of operation

The transmitter shall be operated under the conditions given in clause 4. These conditions shall be clearly stated together with the conditions of modulation.

5.2.9 Methods of measurement of the characteristic frequency of an emission

The characteristic frequency may be measured with any suitable measuring device, provided that the accuracy attained during the measurement is better than approximately 10 % of the frequency tolerance or the frequency stability given in the relevant equipment specification of the transmitter.

For a tight frequency tolerance or a high degree of frequency stability, the measuring accuracy stated above puts higher demands on the accuracy of the measuring equipment.

Other methods of great precision use a standard reference frequency, the frequency of which is known with high accuracy. With such methods, the reception of a standard frequency transmission may be used to advantage.

When the frequency is to be measured as a function of time, measurements shall be made at intervals which are short enough to reveal the presence of superimposed periodical variations. In this case, the measurements shall preferably be made with a recording instrument.

The accuracy of the measuring method, if known, shall be stated with the results of the measurements. If not known, an estimate should be given.

The conditions of operation shall also be given together with the assigned frequency of the emission which has been used as the characteristic frequency.

5.3 Output power

5.3.1 General note on output power

Dependent on the class of emission, the output power of a broadcast transmitter is expressed in terms of mean power, carrier power or peak envelope power as defined below, under specified conditions when the transmitter is connected to a test load.

5.3.2 Mean power

The mean power of a broadcast transmitter is the power under specified conditions of modulation, averaged over a sufficient period of time.

5.3.3 Carrier power

The carrier power of a broadcast transmitter is the average power supplied to a test load under conditions of no modulation; for each class of emission, the condition of modulation should be specified.

5.3.4 Peak envelope power

The peak envelope power of a broadcast transmitter is the power supplied to a test load at the highest crest of the modulation envelope taken under specified conditions of modulation.

5.3.5 Conditions of operation

The transmitter shall be operated under the conditions given in clause 4. These conditions shall be clearly stated together with the conditions of modulation.

5.3.6 Methods of measurement

In general, quantifying output power relies on measuring either the thermal effects of the power dissipated in the test load or the RF voltage across it. The method chosen will depend largely on power output, category of service and characteristic frequency.

Examples are as follows:

- a) calorimetric methods;
- b) temperature dependent component;
- c) spectrum analyser plus directional coupler;
- d) calibrated receiver plus directional coupler.

Carrier power is a special case of mean power and should be measured in the absence of modulation.

For some classes of modulation, for example TV and DAB, this measurement is not appropriate.